Biomimicry LivingLabs® & Green Harbors Project® : Applying Nature's Solutions

Photo: A. Frankic

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www.umb.edu/ghp

Frankic 2015

In urban harbors, the human built environment replaces the natural environment (like the only remaining natural salt marsh in Boston Harbor, in the photo). As a result, we are losing important ecological functions and services necessary to adapt to env. changes. How can we build human environments that will support both human and ecological needs and functions?

Water, Energy and Food Nexus in nature is based on collaboration and symbiosis.

Frankic 2013

Why Care?

Globally, estuaries have been scientifically monitored and assessed to be highly eutrophic and labeled with a dead fish sign (http://www.vims.edu/research/topics/dead_zones/). We know that they would perform better and healthier if we restore their shellfish beds (specifically oysters), salt marshes and eel grass beds together, in collaboration and not separately in competition!
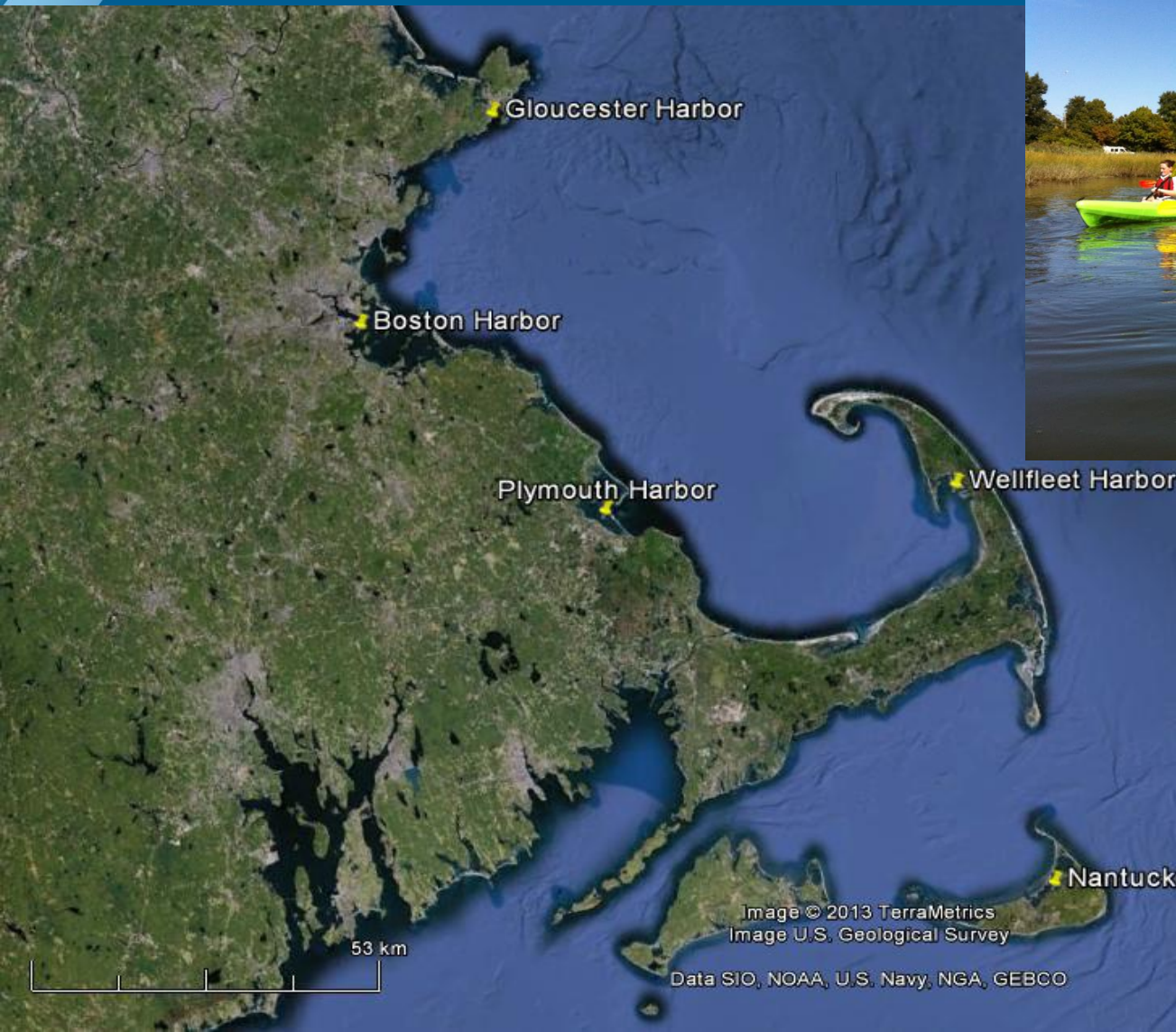
Gloucester Harbor

Boston Harbor

Wellfleet Harbor

Nantucket Harbor

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
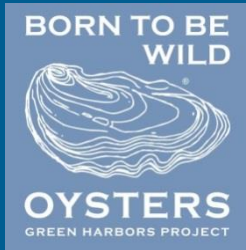© 2013 Cnes/Spot Image

Image © 2013 TerraMetrics

212 km
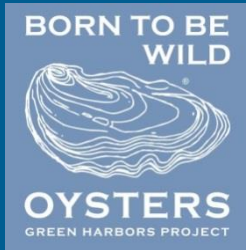
Google earth

Our solution:
Biomimicry LivingLabs®

Green Harbors Project®: Biomimicry LivingLabs®

www.umb.edu/ghp

Making urban harbors healthy, wealthy and resilient, here and now;

Applied science, research and technology on local level in collaboration with local communities and businesses.

Coastal Keystone Habitats in NE

- Salt Marsh

- Shellfish beds

- Eel grass beds

Biomimicry approach is to restore the three coastal keystone habitats together (mutually) ([Frankic et al, 2011](#)):
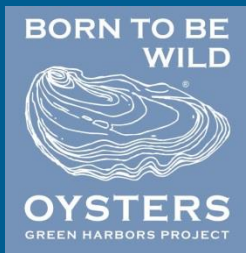
Photo: R. Zottoli

Photos: A. Frankic

What is the ratio between those three systems in nature? How can we apply it in built environments?

We know what are
the missing Ecological Functions & Services
without salt marshes and oyster reefs:

Ecological Functions & Services			How can harbors replace and support missing eco. services?
Nutrients/ total nitrogen take	~ 21gN/m²/y	~1.0 – 2.0 gN/y	oyster reefs & living shorelines
Carbon Sequestration & pH buffer	~ 210gCO₂/m²/y	42% dry weight soft tissue; and 11% in shell mass (CaCO₃)	Oyster reefs, Green cement, Recycled shells, salt marsh
Sediment accretion and oxygenation	~ 1.3 cm/y (vertical accretion)	Bioturbation;	Oyster reefs, Salt marshes
Water storage, Filtration, Bioremediation,	1 acre = 1mill gallons of water	30-50 gallons/day Natural coastal engineers	Oyster Reefs, Salt marshes

Data Source: Feagin et al. 2010; Shepard et al, 2011; Beck et al, 2011, Frankic et al, 2011; Carmichael et al. 2012; Kellogg et al. 2013; Rose et al. 2014; (Note: eel grass beds are the third keystone coastal habitat that is missing)

One-acre wetland can on average store about three-acre feet of water, or one million gallons (EPA, 2006)

www.Shellshocked.com

Images A. Frankic

Example: Water Quality Issue in Savin Hill Cove

Enterococcus Abundance (EPA limit is 104 col/100 ml)				
	Dock Fox Point		**CSO Patten Cove**	
Date	Dry Sample (MPN)	Wet Sample (MPN)	Dry Sample (MPN)	Wet Sample (MPN)
10/22/14		10		<10
10/24/14		>200.5		>200.5
10/31/14	31		560	
11/10/14	<10		20	
11/24/14		31		885
11/25/14		53		87
12/15/14	192		164	

Free Open Course Coasts & Communities

Proposal for Boston living with watercompetition
https://www.youtube.com/watch?v=xr9vvhA

Savin Hill Cove, Biomimicry LivingLabs:
Floating Island without vegetation and planting cord grass

First oyster reef restoration in Boston Harbor

Established 10K native oysters (C. virginica) naturally in 4 years

C. virginica - 500 (625**)
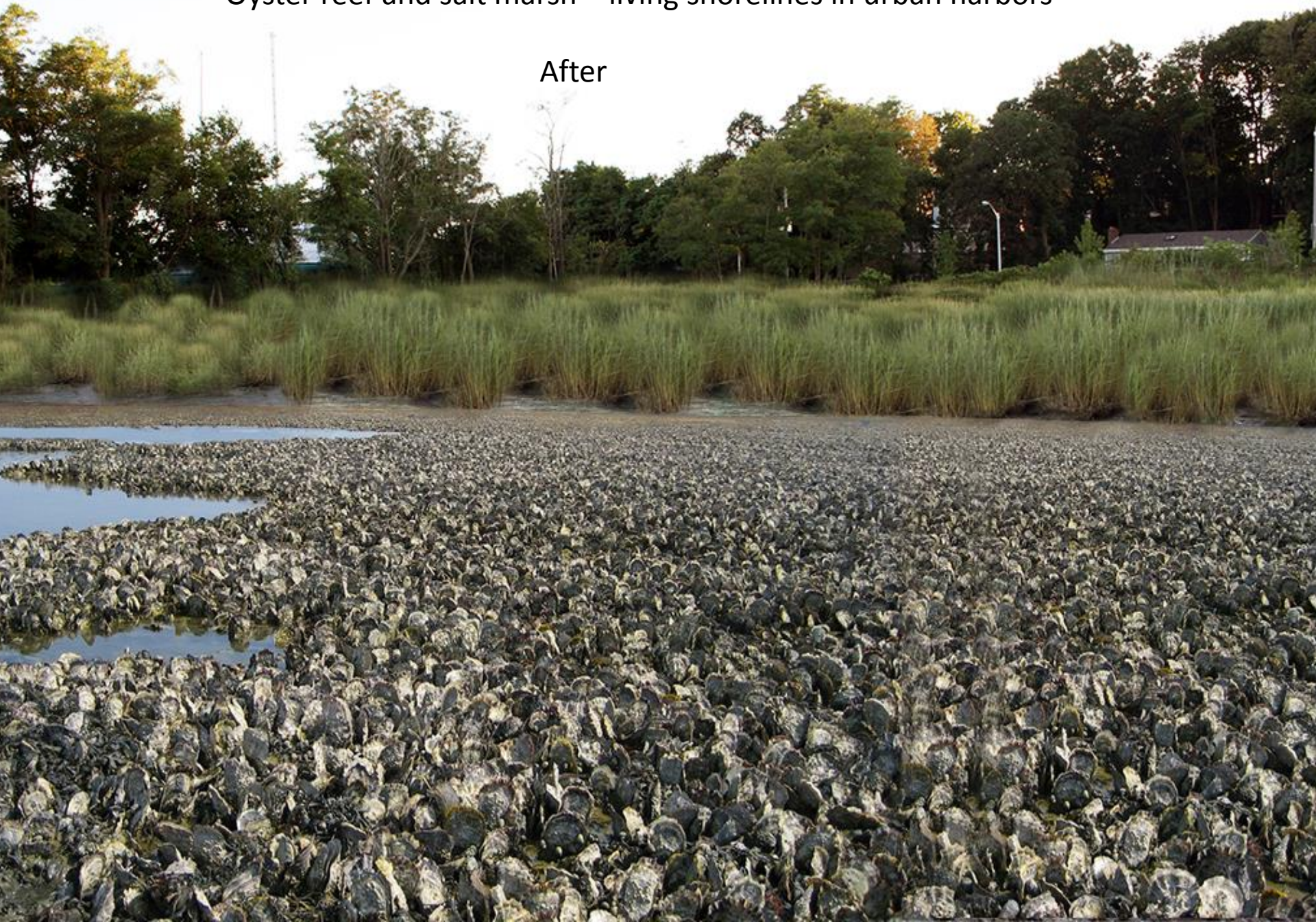*O. edulis - 280 (350**)*

C. virginica - 96 (110*)
O. edulis - 183 (210*)

C. virginica - 438 (504*)
O. edulis - 125 (144*)

C. virginica - 0
O. edulis - 0

C. virginica - 0
O. edulis - 78 (90*)

C. virginica - 53 (61*)
O. edulis - 807 (928*)

C. virginica - 32 (37*)
O. edulis - 119 (229*)

C. virginica - 130' (150'*)
O. edulis - 210 (242*)

C. virginica - 26 (30*)
O. edulis - 42 (48*)

C. virginica - 16 (18*)
O. edulis - 110 (127*)

C. virginica - 70 (81*)
O. edulis - 708 (814*)

Total oyster estimation:
Crassostrea virginica - 1361 (1615*)
Ostrea edulis - 2742 (3181*)

* Applied correction factor of 15%
** Applied correction factor of 25%
' Upscaled data based on transect 5-6

Data collected on Wednesday November 20, 2014
and Monday December 15, 2014
D. Bertuna, D. Winders & S. Sears

50 m

Before

Savin Hill Cove Biomimicry LivingLabs

Oyster reef and salt marsh = living shorelines in urban harbors

After

Free Open Online Course: Coasts & Communities   Savin Hill Cove, Biomimicry LivingLab,
                                                        Boston MA

Photo by A. Frankic

Wellfleet Harbor, Oyster reef restoration 2012-14

Total Nitrogen (uM [mg/L])
- < 21 [0.30] - Excellent
- 21-27 [0.3-0.39] - Good
- 27-35 [0.39-0.50] - Fair
- 35-50 [0.5-0.7] - Moderate Impairment
- 50-57 [0.7-0.8] - Significant Impairment
- > 57 [0.8] - Severe Degradation

Nitrogen Sink

Water around oyster project is higher in nitrogen ranging from fair to severe degradation

Source: Amy Costa and Anamarija Frankic (PI)

8-7-11

Oyster habitat restoration in Duck Creek, **Wellfleet Harbor,** Images: A. Frankic

10-16-13
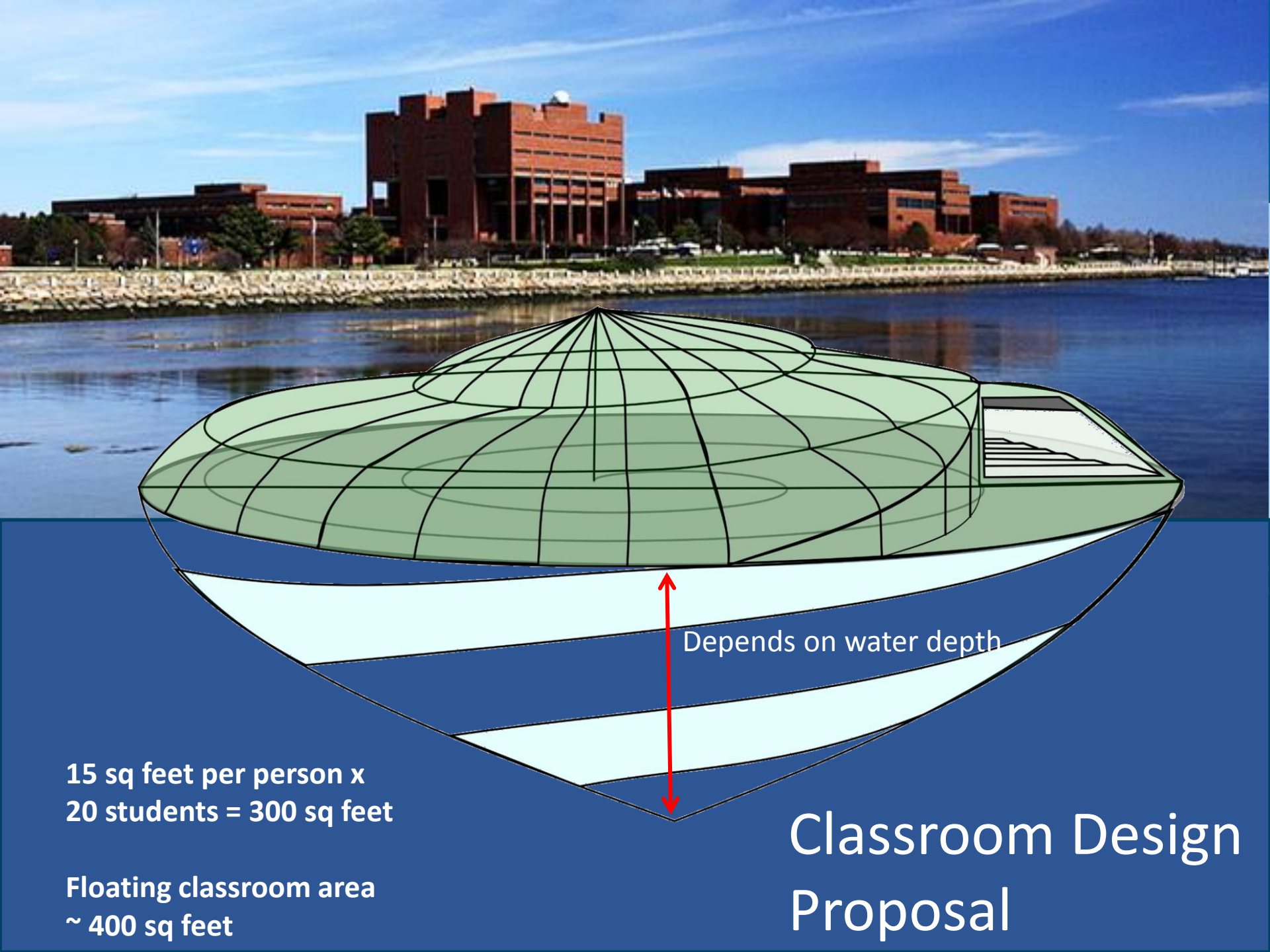
2 acres, 3 years = 5.8 mill oysters

Jess
and
Deniz

Biomimicry Class Presents:
Floating Classroom Proposal

UMASS BOSTON

Biomimicry LivingLabs
in Savin Hill Cove

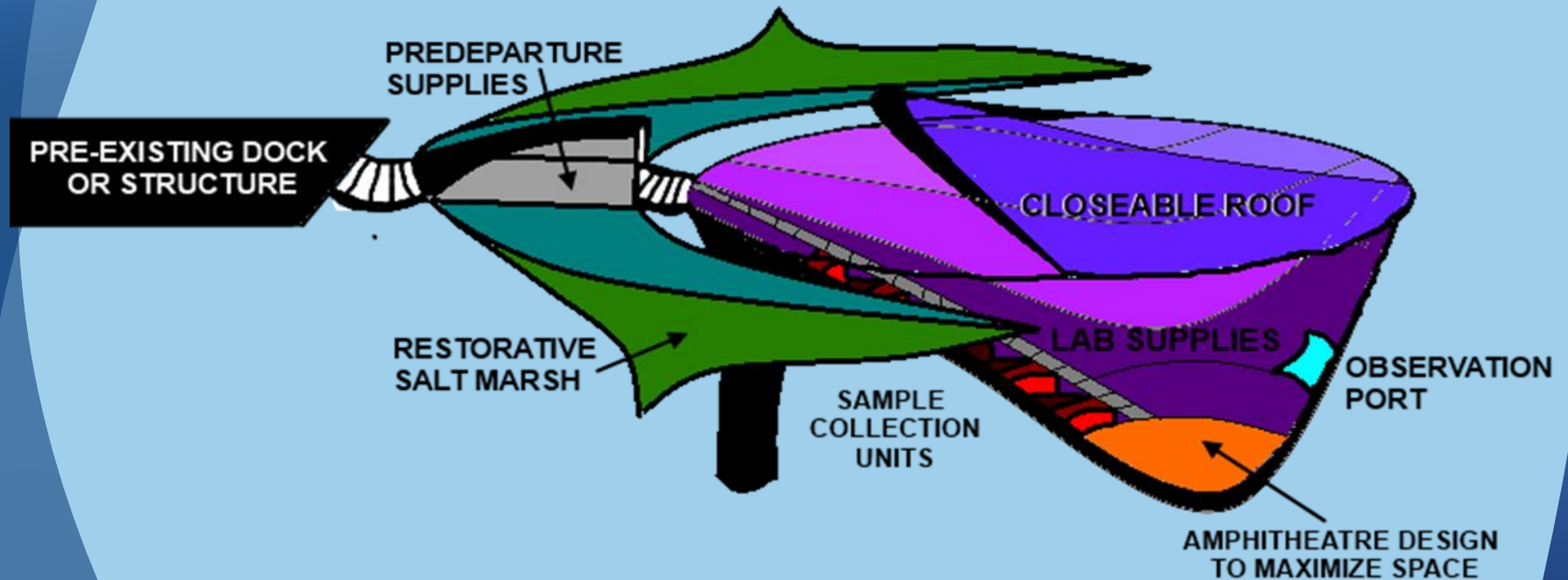How would nature design and build a Floating Classroom?

Google earth

Depends on water depth

**15 sq feet per person x
20 students = 300 sq feet**

**Floating classroom area
~ 400 sq feet**

Classroom Design
Proposal

Mobile Floating Classroom
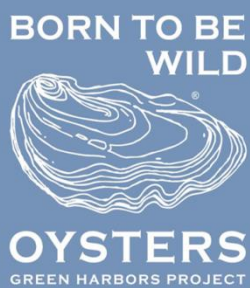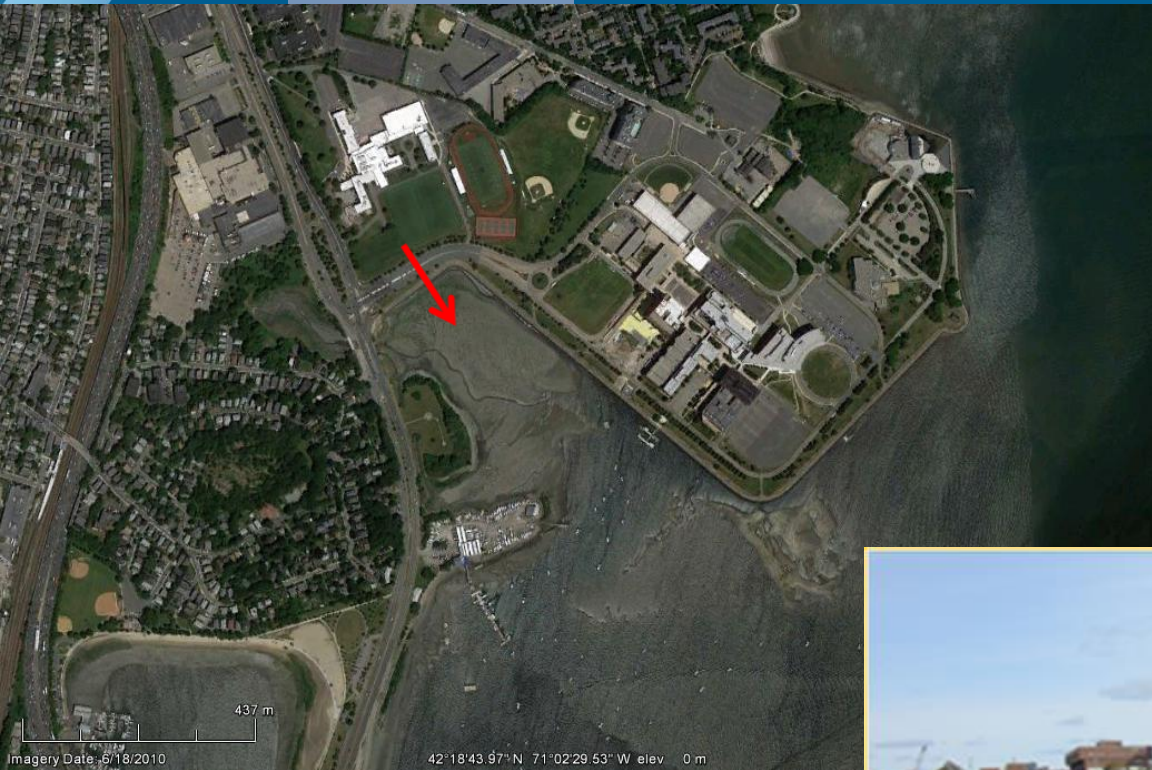
Biomimicry LivingLabs® for green harbors

BORN TO BE WILD

OYSTERS
GREEN HARBORS PROJECT

1000s of students were introduced to biomimicry, from K-12 to graduate degrees;

GHP won the President's higher education community service award, and Citi of Boston award;
www.biomimicryNE.org

GHP has been funded by EPA, NOAA, the MIT Sea Grant, local community, and

SCHMIDT FAMILY FOUNDATION

Vision of the future

Picture taken by Danielle Hughes and merged with a picture from www.iftantillo.com.

Adopt a student for a green job!

Green Harbors Project (GHP)

THANK YOU!